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Development and Function of Consequence Classes in Operant Behavior

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The term *class* has been discussed extensively in the behavioral literature for groups of stimuli or responses that share a common function. In contrast, the concept of consequence class, including its definition, its formation, and other relevant characteristics, has not been the topic of much attention in the literature. Issues pertaining to consequence classes are discussed to provide a more thorough analysis of the units of operant and discriminated operant functional relations. The concept of class for consequences provides a means to integrate data and theory from the behavior-analytic literature.

Key words: consequence class, class, consequences, behavioral economics, class formation, reinforcing class, punishing class

Substantial advances in the understanding of physical phenomena have come after discovering their basic units of analysis. These units serve as a basis for experimental study and permit the ordering of disparate facts and phenomena (Zeiler, 1986). Cell theory and atomic theory, for example, have provided basic units of organization. As a consequence of these theories, great strides have occurred in basic and applied biological and physical sciences. Over the centuries, scholars also have studied and attempted to explain the behavior of organisms, in some cases as a physical phenomenon and in some cases otherwise. The behavior of organisms has been attributed to various influences, both outside the organism (e.g., earth, water, air, and fire) and within the organism (e.g., soul, reflex arc). The reflex, which is said to integrate neural units, was proposed as a basic structure by Sherrington and Pavlov (Zeiler, 1986). Watson proposed that behavior itself could be a functional rather than structural unit of analysis and subject to scientific investigation.

Subsequently, Skinner initiated a career of scientific investigation of behavior as a fundamental unit of analysis. Skinner (1931) attributed the concept of reflex to all living organisms, and defined it in a manner that related a response as a function of a stimulus, $R = f(S)$. Skinner (1935) extended the function of individual stimuli and responses to classes, whose members are variations of each other but, nevertheless, have common functional effects. According to Skinner (1935), a class is generic in nature and "embraces an indefinitely large number of particular stimuli or responses but is sufficiently well defined by the specification of one or two properties" (p. 42). After defining the properties of a class, its membership is discovered by exploration (Skinner, 1938). Members may be added to the class as their common effects are observed.

The science of behavior has identified several basic functional relations, including operants (R-S), respondents (S-R), and discriminated operants (S-R-S). The concept of class is applicable to the stimuli and responses involved in each of these functional relations. In the case of discriminated operants, the antecedent stimulus class

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need share no common property among class members other than that they all evoke the same response (Skinner, 1938). Various antecedent stimuli may share a common functional effect with a particular class of responses; the stimuli in the class evoke the same response. Likewise, topographically different responses in the three functional relations described above may be members of a response class because they are controlled by members of the same stimulus class.

Behavior analysts have extensively described and researched classes related to antecedent stimuli and responses. Such critical examination has not taken place to the same degree, however, for the consequences of operants and discriminated operants. Although there is a substantial literature on response consequences and their effects, the terms *reinforcing classes* and *punishing classes* have been applied only to large general sets of stimuli (Catania, 1998). Likewise, brief mention has been made that the concept of stimulus class can be applied to response consequences with two subsets, positive and negative reinforcers (Johnston & Pennypacker, 1993; Pierce & Epling, 1999). Consequence classes, however, have not been widely discussed in behavioral textbooks, conceptual articles, or research articles. For conceptual completeness and symmetry of analysis, the concept of class for consequences should be considered further. A consequence class is a basic unit whose analysis should help us to understand the functional relations of operant behavior and to unify extant theory and data.

Discussion of this concept also may have heuristic value for promoting basic and applied research as well as the practice of behavior analysis. Consideration of consequence classes also is timely with respect to the burgeoning behavioral literature pertinent to the functional analysis of the problem behavior (e.g., self-injury) of persons with severe disabilities. The determinants of problem behavior have been the subject of considerable research and discussion in recent years. That literature indicates that several classes of setting and stimulus events account for the acquisition and maintenance of problem behavior. The stimulus events include various classes of response consequences that have been categorized as social attention, tangible items, escape, and sensory feedback (Durand, 1990) or variations thereof by other researchers. Each of these classifications may represent one or more subclasses of specific types of consequences that maintain problem behavior in natural environments.

Another applied rationale for the examination of consequence classes pertains to recommendations for the effective implementation of reinforcement. It has been suggested that a variety of reinforcers should be introduced to reduce the probability of satiation (Sulzer-Azaroff & Mayer, 1992). If the various consequences delivered by a contingency manager all have the effect of strengthening or maintaining the same behavior, then they may be members of the same class of consequences. If the novel consequences are not members of the same class, then they may not be effective reinforcers. Only consequences that are members of the same class would function as reinforcers. Prior to a discussion of the concept of class for consequences, the concept of class per se will be considered.

On the Concept of Class

As stated previously, the term *class* denotes a group of elements that share a common property or feature, such as topography or function (Skinner, 1935). This term is most commonly used in behavior analysis to denote the latter, a group of members that have a common functional outcome. Class members may be stimuli that vary in physical dimensions but nevertheless have the common effect of eliciting or evoking members of the same response class. In addition to stimulus classes, there may be classes of responses. Re-

sponse class members are topographically different to varying degrees but still produce similar consequences. This basic functional characteristic of classes for groups of stimuli and responses seems to apply equally well for response consequences. There are consequences that vary with respect to their physical properties but have the common function of either reinforcing or punishing the members of the same response class.

According to this basic definition of class, its sole characteristic is that its members produce the same effect on the environment. Nothing more is required. That functional aspect of a class is the primary characteristic emphasized in many behavioral texts. Sidman (1994), however, stated that to define a class solely on the basis of commonness of function is to limit the utility of classification. Within the broad concept of a functional class, its utility can be enhanced by further restriction of other defining properties (Skinner, 1935). Commonness of function is a necessary prerequisite but is not a sufficient characteristic of class membership. Other defining properties have been articulated that might promote the utility of the concept of class.

A second characteristic is that there are stimuli and responses that do not share a common function with others; therefore, they are not members of a specified class (Sidman, 1994). They may or may not be members of another class. Various verbal, textual, and other visual stimuli, for example, comprise an antecedent class that occasions members of the response class entering a door. Most stimuli that comprise an antecedent class for greeting someone (e.g., the sight of a person, the other person initiating a greeting) are not members of the stimulus class for entering a door and do not occasion members of that response class.

Another class characteristic is that a larger class may be partitioned into subclasses by further restricting the specification of the parent class (Skinner, 1935). The stimuli or responses that comprise the class could be delimited with respect to their characteristics to create subclasses. The subclass members would all have the same general effect but can accomplish that effect with elements that share a restricted set of properties. The stimulus class for entering a door might be partitioned into textual, verbal, and nonverbal discriminative stimuli. A large response class termed "greeting people" may be subdivided into vocal and nonvocal subclasses. It is possible that there could be further partitioning into more delimited subclasses.

Another property discussed in the literature with respect to stimulus and response classes is the spread of effect (i.e., transfer of function, induction, generalization). When a behavioral operation is performed on one member of the class, the effect spreads to other members of the same class that are not direct recipients of that operation (Goldiamond, 1962; Michael, 1993; Sidman, 1994; Skinner, 1935). For example, if one member of a response class (e.g., off-task behavior in school) is punished, will there also be a reduction in the future probability of occurrence of other members of the same class? If so, then the members of that class share more than a common function. They also share a transfer of effect from one member to another.

If groups of stimuli, responses, or consequences share a common function, but they are not affected to some degree when an operation is performed on one ostensible class member, then there is not a true class according to the additional stricture of spread of effect. If there is no transfer of function among elements of an ostensible class defined purely on the basis of function, then the elements would be a group of independent instances that each share a correlation with a common function (i.e., stimuli with responses, responses with consequences, and consequences with responses). The elements may be grouped into a nominal class only because of the functional relation that they have in common with another var-

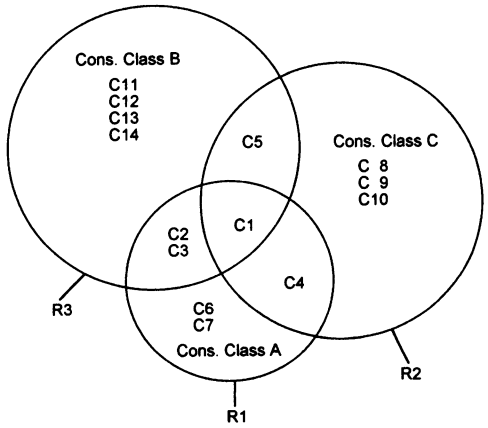

Figure 1. Reinforcing consequence class, three illustrative subclasses, and subclass members. C1 is a generalized reinforcer for R1, R2, and R3. C2 and C3 are generalized reinforcers for R1 and R3. C4 is a generalized reinforcer for R1 and R2. C5 is a generalized reinforcer for R2 and R3. C6 and C7 are reinforcing subclass members for R1. C8 through C10 are reinforcing subclass members for R2. C11 through C14 are reinforcing subclass members for R3.

iable, but they are not mutually affected by influences on each other. The above-cited characteristics of a class, which have been discussed extensively for stimuli and responses, seem to be relevant to consequences as well. Unfortunately, the articulation of these class characteristics for consequences has not occurred to the same degree. The purpose of the present discussion, therefore, is to bridge that gap and examine the relevance of the concept of class to consequences.

Consequence Class Model and Example

Figure 1 presents a model of Consequence Classes A, B, and C, whose members are reinforcers or punishers of Response Classes R1, R2, and R3, respectively. The number of consequence class members may vary from class to class. Some consequences may function as reinforcers or punishers exclusively for one response class, such as C6 and C7 for R1 in Consequence Class A. Consequences also may serve as reinforcers or punishers for more than one response class, shown by those elements that lie in the area of overlap of the classes (e.g., C4 is a reinforcer or punisher for R1 and R2). These consequences may be generalized reinforcers or punishers because they have a common effect on multiple response classes. The degree of generalization would be correlated with the number of classes that contain the same consequence. In addition, R1, R2, and R3, collectively, are also part of the same larger response class because they all produce a common consequence, C1. Overall, the figure shows that consequence classes are designated by elements that share a common reinforcing or punishing function.

The above model can be illustrated with an example from education. Assume that there are three response classes: R1 = spelling, R2 = prompt school arrival, and R3 = having all necessary work materials. Referring to Figure 1, an elementary school child's spelling (R1) may be strengthened or maintained by two different consequences, labeled C6 and C7 (e.g., candy, access to a video game). These reinforcers may be members of the same consequence class because they have the same strengthening effect on the response class of spelling; they are effective reinforcers only for spelling. Prompt school arrival (R2) may be strengthened or maintained by three other reinforcers, identified as C8 through C10 (e.g., a note from the teacher to the parents, a telephone call from the teacher to the parents, extra recess). These reinforcers may be members of the same consequence class for the response class of prompt school arrival, and they are effective only for this behavior. There is one reinforcer, say engaging in peer tutoring and labeled C4 in Figure 1, that falls within the area of overlap of Response Classes 1 and 2. This signifies that engaging in peer tutoring serves as a reinforcer for both spelling and prompt arrival. There is one reinforcer, C1, that serves as a reinforcer for all three re-

sponse classes. Whether multiple consequences that have a common effect constitute a class depends on the satisfaction of the other definitional requirements for a class, such as transfer of function.

All reinforcers in one consequence class cannot be assumed to be members of a second consequence class just because some members of the first class are also in the second class. In Figure 1, C4, C6, and C7 are in the consequence class for Response Class 1, but only C4 is also in the consequence class for Response Class 2 (along with C8 through C10). C6 and C7 are not reinforcers for Response Class 2 just because they are reinforcers in the consequence class for Response Class 1. Class membership must be empirically determined and defined relative to the classes of operants for which response classes and consequences are arranged.

Punishing Consequence Class

The above analysis can be extended to punishing consequence classes, which are conceptually and practically analogous to reinforcing consequence classes. According to the literature cited previously, there is a large general consequence class of aversive stimuli, whose members share the common functional property of reducing the members of a response class. This large generic class also is composed of subclasses based on restriction of their defining properties. For example, there may be a class of aversive stimuli that reduce a student's off-task behavior. The consequence class may consist of a teacher's verbal reprimand, as well as time-out from recess, a telephone call from the teacher to the parents, and a number of other aversive consequences. Analogous to reinforcing consequences, aversive consequences may serve as generalized punishers for more than one response class. If all these examples of potentially aversive stimuli serve the same function of reducing the response class of the student's off-task behavior, then they meet the first requirement of being members of the same functional punishing class.

An applied concern with respect to the use of aversive consequences is adaptation of responding over trials to the same aversive stimulus, especially with low-intensity stimuli (Sulzer-Azaroff & Mayer, 1992). Perhaps varying equally effective, but novel, aversive consequences that are members of a class may forestall adaptation in a manner analogous to the prevention of satiation by varying positive reinforcers. The substitutability of aversive consequences is an empirical question that should be investigated further.

Consequence Class Formation

An issue that should be considered is how consequence classes develop. How do primary and secondary reinforcing or punishing stimuli become members of a class? Because consequence classes are defined, in part, by their function, consequences become potential class members initially by virtue of affecting the same response class in the same manner. Functional classes do not preexist based on physical or other structural similarities among consequences; class composition by function must be empirically determined.

Consequences may enter the class either independently of each other or by a conditioning process, such as that described by the Rescorla-Wagner (Rescorla, 1988) and behavioral discrepancy (Donahoe, Crowley, Millard, & Stickney, 1982) models. The conditioning avenue of entry involves stimulus–stimulus contingencies with other established consequences that are either outside or inside the class. When reinforcers enter the class by conditional relations with other consequences, those relations could be either natural or programmed. Consider a class of reinforcing stimuli for academic behavior consisting of a teacher's praise, a star on a worksheet, and a cookie.

The class consists of social, symbolic, and primary reinforcers. Primary reinforcers, such as the cookie, may enter the potential class at any time as natural reinforcers independently of other primary reinforcers and other existing class members. The basis of the effectiveness of primary reinforcers may be in the organism's genetic endowment and in more local operations, such as deprivation.

Other consequences may become class members by various learning processes, for example, via stimulus generalization. Class membership may be extended by generalization across topographically similar stimuli. The teacher's praise may take on reinforcing value initially because it is similar in relevant topographical dimensions to the praise provided by the student's mother, which already is a reinforcer for the child's behavior at home. There may be unprogrammed generalization across settings, people, student responses, and verbal dimensions from a consequence outside the class (mother's praise) to an initially neutral stimulus (teacher's praise) that will enter the class of reinforcers for academic behavior.

There also may be unprogrammed transfer of function across consequences. For example, the effects of delivering stars, which already are reinforcers for academic behavior, may affect or transfer to other symbols that will become reinforcers and class members (e.g., smile face on paper, pumpkin stamped on hand). The exemplified symbols may function as reinforcers because they already are members of an equivalence class of symbols. The individual may have a prior history with these or similar symbols in other contexts that established them as an equivalence class, and the development of one member of the class as a consequence may transfer to other members of the class (Dougher & Markham, 1996).

It also may be the case that symbols such as the star, smile face, and pumpkin are initially unknown, neutral symbols. Assume the student has a history of receiving a grade of A contingent on completing a worksheet at least 90% correctly, but not if the worksheet is not 90% correct. Assume the A has a prior history as a conditioned reinforcer. Conditional upon completing a 90% correct worksheet, the teacher may substitute a novel neutral symbol, such as the star for the A. The star may acquire reinforcing value because of this contingent relation with the high performance criterion and enter the consequence class as functionally equivalent to the A.

This situation may be described as follows. Both the A and the star are conditional on meeting the 90% criterion, and are not given if the criterion is not met. Thus, there is a conditional relation between the 90% criterion (A) and the grade of A (B), and the 90% criterion (A) and a star (C). With the A-B and A-C relations established, B and C then come to function as equivalent reinforcing stimuli because of their mutual conditional relation with A, the 90% criterion. This history may have produced both a functional class and equivalence class consisting of the three symbolic reinforcers and the criterion. Whether or not the symbols transfer functions or meet the criteria for equivalence can be determined by experimental manipulation.

The mechanism by which the star becomes a reinforcer also can be explained by the unified principle of reinforcement that accounts for the selection of behavior (Donahoe et al., 1982; Donahoe & Palmer, 1994). A change in the student's ongoing behavior (e.g., from responding indifferently in the presence of the star to engaging in academic responses) results from the temporal contiguity between the star and the student's behavior, plus a change in the ongoing behavior that occurs in the presence of the star (i.e., a behavioral discrepancy). When the discrepancy occurs, an environment–behavior relation is established between the stimuli that occur immediately before the discrepancy and con-

temporaneous responses (Donahoe & Palmer, 1994). As with the Rescorla-Wagner (1988) model, the behavioral discrepancy model requires not only temporal contiguity but also a behavior–environment contingency.

The consequence class also may expand in a manner analogous to that for the establishment of generalized secondary reinforcers (i.e., by being contingently paired with existing reinforcers and creating a behavioral discrepancy). Prior to becoming a secondary reinforcer, the initially neutral star symbol was contingently paired with the teacher's praise, an established conditioned reinforcer. The symbol became a class member by a programmed conditional relation with an existing class member. For conditioning to occur, it is important that there be a conditional relation (contingency) between the praise and the star and not merely temporal contiguity (Donahoe & Palmer, 1994; Rescorla, 1988). Entry into a potential consequence class, therefore, may come via the direct route of primary reinforcers, stimulus generalization, stimulus equivalence, or a programmed conditioning process of producing secondary reinforcers. These routes may be supplemented by contingency-specifying rules and contemporaneous delivery of other established reinforcers. Class development for aversive stimuli occurs in an analogous manner.

Identifying the specific route of entry into a consequence class from the alternatives described above may be difficult or impossible for some members, especially in natural contexts for humans. For example, consider Figure 1 as an abstract model in which C4 is a reinforcer for both Response Classes 1 and 2. Did C4 become a reinforcer for these two response classes because of its previous natural contingent relation with one or more members of the two consequence classes, or did it become a class member independently of any association with existing class members? Is C4 an independent reinforcer for two different response classes, or did it become a reinforcer by stimulus generalization, stimulus equivalence, or programmed conditioning with existing reinforcers?

For purposes of class definition, these questions are irrelevant. C4 is a member of the consequence class regardless of how it came to have a common function with other reinforcers in the class. For purpose of forming classes, however, it is an intriguing question. Primary reinforcers, it might be assumed, usually are reinforcers in their own right. They do not need to be contingently associated with other class members. For secondary reinforcers, on the other hand, the situation is more ambiguous. Clues to the origin of a class member might be found by investigating the contingent relation between the consequence and the response class, and its history of contingent relation with other class members. This same issue also is germane to antecedent stimulus classes in discriminated operants.

The origin of class members could be investigated more definitively in a laboratory in which an organism's history with consequences could be controlled. The effect of novel consequences on a response class could be tested initially without a prior history of a contingent relation with known reinforcers, and then with a contingent relation with the reinforcers. In such a highly controlled environment, if novel consequences reinforce the response class initially, that would suggest that the reinforcers are effective in their own right. If they are not effective reinforcers initially, but become so only after contingent pairing with established reinforcers, then that would suggest that their entry into the class was by the contingent relation with consequence class members. The degree of control afforded in the laboratory is not present when observing humans in natural environments. Accounting for the origin and route of entry of consequences into a class will be difficult, if not impossible, in many cases.

Permanence of Class Membership

In addition to the mechanisms of class formation, a related matter is the degree of permanence or continuity of consequence class membership. Membership of elements in consequence classes may be more dynamic than that for stimulus and response classes. Preferences or hierarchical rankings of reinforcers may change over time as an organism continually interacts with the environment. That interaction brings the organism into contact with new consequences that take on a reinforcing function and become preferred, whereas some current class members may lose their reinforcing function. For example, the quality of reinforcement of a star on a third-grade child's paper may diminish over time, and the opportunity to play a new video game may become a preferred higher quality reinforcer after the student comes into contact with the game.

Establishing operations also affect consequence classes by temporarily altering their members' reinforcing or punishing functions (Michael, 1993). These effects may transiently change the relative preference and effectiveness of class members. Consequences affected by the establishing operation of satiation, for example, have not dropped out of the class; they temporarily become either ineffective or less effective members with respect to a response class. When that occurs, another class member unaffected by the function of the establishing operation may be a more effective alternative at that time for the response class. The effects of establishing operations may be a basis for the further partitioning of consequence classes into subclasses with similar functions.

For example, satiation for juice, an otherwise preferred reinforcer, may temporarily reduce the effectiveness of the beverage as a reinforcer for the dressing behavior of a student with severe mental retardation. At that time, a hug may be an effective alternative reinforcer because it is a member of the class but is unaffected by juice satiation. Class composition and the effectiveness of its members may fluctuate over time, therefore, with the same consequence entering and exiting the class or being temporarily ineffective as the organism interacts with the environment. The subclass of reinforcers affected by satiation may be partitioned from those not similarly affected. This issue will be discussed later in the context of transfer of function of class members.

Another factor that might influence consequence class composition at a given time is the relative nature of reinforcers and the response class being reinforced. That relative relation has been conceptualized in more than one manner in the behavioral literature. The Premack principle, for example, states that contingent access to high-probability behaviors, such as engaging in preferred activities, can reinforce engaging in low-probability behaviors. A probability ranking or hierarchy could be created in which access to a given response class that is intermediate in probability could serve as a reinforcer for lower probability response classes and, in turn, be the response class reinforced by a higher probability response in the hierarchy. Those relative behavioral probabilities could shift over time and thereby affect the composition of consequence classes.

Another explanation of this relative reinforcement phenomenon is the response deprivation hypothesis (Timberlake & Allison, 1974). It states that when access to behavior is restricted below its baseline level, organisms will engage in alternative behavior to gain access to the response that has been withheld. The implication for consequence classes is that class membership may be influenced by the level of deprivation of a response relative to others. To focus merely on class composition and the common reinforcing or punishing function of the members may overlook the various dynamic mechanisms that resulted in the con-

sequence entering and remaining in the class.

Positive reinforcers or punishers vary from individual to individual; therefore, the consequence class composition will differ across organisms of the same species. These classes may be more idiosyncratic across different organisms than stimulus and response classes are. As is the case for the latter classes, consequence classes also reflect interorganism differences at any moment in time and intraorganism differences over time.

Consequence Classes and Transfer of Function

As stated previously, it has been argued that the elements of a class must share more than a common function; they also must demonstrate a transfer of function from one member to another (Goldiamond, 1962; Michael, 1993; Sidman, 1994; Skinner, 1935). Operations applied to one element should affect other elements of the class. Assume, for example, that we have an ostensible consequence class based on the initial defining characteristic of shared function consisting of orange juice, milk, a star, a hug, and praise. They all serve as reinforcers for the same response class, such as some aspect of a child's expressive language. If we stipulate that an operation on one must affect other class members, then these consequences may or may not be members of the same reinforcer class.

Transfer of function might be more likely to occur when multiple consequences are affected by the same establishing operation, as discussed previously. For example, satiation for liquids might temporarily reduce the effectiveness of both orange juice and milk to function as reinforcers but will not affect the power of symbolic and social consequences. Also, if the person who delivers different forms of social reinforcement, such as the hug and praise, becomes a conditioned aversive stimulus, then the effectiveness of both of these social consequences as reinforcers might be reduced, but will not affect food and beverages as reinforcers.

What is the implication of transfer of function for class definition? If we stipulate transfer among class members as an essential defining characteristic of a class, then we might further partition our larger class into subclasses of elements that share transfer of function. In the example above, we might have separate subclasses of beverage and social reinforcers. Subclasses of reinforcers may be independent of each other, but both subclasses are correlated with a common function (e.g., they may reinforce expressive language). The specification of subclasses based on transfer of function or spread of effect should be empirically determined for consequence classes, as it is for stimulus and response classes.

Consequence Classes and Behavioral Economics

The concept of consequence class in behavior analysis bears a relation to the concept of substitute goods in economics. This relation may be helpful for answering some questions related to transfer of function. Goods are substitutes for each other if they "satisfy most of the same needs" (Duffy, 1993, p. 15) or "can be used in place of one another" (Colander, 1995, p. 494). Based on these definitions, substitute goods may be members of a class because they serve a common function. If those substitute goods serve a reinforcing function, then we could consider them to be members of an ostensible consequence class and be affected by the issues discussed here. Access to substitute goods, for example, may reinforce work behavior that has as a more immediate consequence the receipt of money, a generalized reinforcer used to purchase the substitute goods.

From an economic perspective, goods may be either perfect or imperfect substitutes for each other (Varian, 1996). A blue pen and a black pen may

be perfect substitutes for many functions, but a pen and a pencil may be imperfect substitutes for some of those same functions. As another example, coffee and tea may be perfect substitutes for some individuals, but may be imperfect or, in fact, nonsubstitutes for other people. In the context of consequence classes, perfect substitutes may have a transfer-of-function characteristic and also may be more enduring class members than imperfect substitutes are.

According to economists, there are several variables that affect the number of substitutes a good has and its demand elasticity (Colander, 1995); these variables may have implications for consequence classes. One factor is the time interval considered. The longer the time, the more opportunity there is for goods to become substitutable (or reinforcers to enter the class). This is consistent with the previous discussion on consequence class formation and the time that it may take for classes to form regardless of mechanism.

A second variable that affects the number of substitutes a good has and its demand elasticity is the degree to which a good is a necessity or a luxury. There are fewer substitutes for necessities, and their demand curve is less elastic. This implies that the consequence class of necessities would be smaller than the consequence class of luxuries. Perhaps an imperfect analogy from behavior analysis is that necessities are primary reinforcers and luxuries are secondary reinforcers.

A third variable that affects the number of substitutes is the degree of specificity of the definition of the goods. There is a direct relation between the two. If goods are broadly defined, there are more substitutes. With respect to consequence classes, a broadly defined class, such as food, has many more functionally equivalent members or substitutes and is more elastic than a narrowly defined subclass, such as fresh fruit.

Economists also have demonstrated a relation between price and substitutes. As the price of a good increases, there is a tendency to shift demand to lower cost substitutes, with all else held constant. Conversely, when there is a decrease in the price of a good, there is a decrease in the demand for its substitutes. The price of one good and the demand for its substitutes move in the same direction. The implication for consequence classes is that they are dynamic and cannot be considered independently of price (i.e., response effort, schedule requirements). As response cost increases for a reinforcer, consequence class membership may narrow and fewer consequences will serve as reinforcers. Effective reinforcers may be in a smaller class when the response cost is greater. When schedule requirements are lean and more response effort is required, for example, it may take higher quality or a greater quantity of reinforcers to maintain responding. The consequence class of high-quality reinforcers is smaller than that of high- and moderate-quality reinforcers.

Furthermore, according to economists the rate at which a consumer is willing to exchange one good for another is determined by the relative marginal utilities of the goods, based on a comparison of the ratios of marginal utility to the price of each good (Schiller, 1989).This economic analysis also is compatible with the matching law (Herrnstein, 1997). Organisms will shift responding in a concurrent schedule to the choice on which they receive the same reinforcers for less effort (Cuvo, Lerch, Leurquin, Gaffaney, & Poppen, 1998). The economic principle of consumer choice based on relative marginal utilities and the matching law both imply that consequence classes are dynamic and contextual. The effectiveness of class members is dependent upon the relative cost of obtaining them as well as characteristics of the reinforcers for the response choices themselves. One cannot speak of the effectiveness of a reinforcer, indeed a class of reinforcers, without considering the characteristics of si-

multaneously available classes of reinforcers (e.g., quality, quantity, immediacy) as well as the characteristics of response classes (e.g., topography, effort) that might be emitted.

These issues suggest that economists have developed concepts and principles regarding the substitutability of goods that bear examination with respect to their relevance to consequence classes. The economics literature and the principles pertaining to substitutes, in particular, may help direct research regarding consequence classes. Of course, parallel research by behavior analysts may also facilitate the work of economists.

Conclusions

Reinforcing and punishing consequences, like antecedents and responses, can be designated as members of classes. The members of the class share a common function as a prerequisite characteristic. In addition, a large class can be further partitioned into subclasses based on delimiting the class characteristics. Certain consequences may be members of one or more classes, but some consequences are not members of these classes. Once we clarify the status of consequences as members of classes, we can more easily see that multiple events can share the similar functions of strengthening and weakening operant classes. Consequence class members develop and have characteristics and relations with each other, such as transfer of function, as do the members of stimulus and response classes. The concept of class for consequences provides a basis for organizing many conceptualizations and research findings from the behavior-analytic literature. It is hoped that this discussion of the concept of class will draw focus to it as a subject for future research, as has been the case for stimulus and response classes.

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